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identifying conduction paths in said sensor array as regions having a higher temperature than their surroundings;

assessing the uniformity of the temperature distribution is said regions; and

monitoring the quality of said sensor using said temperature distribution.

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22. (Amended) A method for identifying the conducting path of a sensor, comprising:

applying a voltage to said sensor to cause said sensor to dissipate energy;

capturing an image of said sensor with an infrared camera to generate a thermographic image of said sensor while said sensor is dissipating energy; and

identifying said conduction paths in said sensor array as regions having a higher temperature than their surroundings.

REMARKS

Claims 1-25 are pending in the present application. The presently pending claims were restricted to group I, claims 1-23, drawn to a sensor array device and a method of monitoring the sensor array device and group II, claims 24 and 25, drawn to a computer program that calculates the uniformity of an infrared detector' output. During a telephone conversation with Mr. Joseph Snyder on September 4, 2002, a provisional election was made with traverse to prosecute the invention of group I, claims 1-23. Claims 24 and 25 have been withdrawn from further consideration by the Examiner under 37 CFR 1.142(b), as being drawn to a non-elected invention.

Claims 19 and 22 have been amended. No new claims have been added. Reconsideration is respectfully requested.

I. BRIEF OVERVIEW OF THE CLAIMED INVENTION

In certain aspects, the present invention relates to a sensor array device for detecting an analyte in a fluid, comprising: an infrared detector operatively associated

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with each sensor wherein the detector measures a response in the presence of the analyte. Surprisingly, the inventor has discovered that the use of an infrared detector can monitor a distribution of responses, such as resistances, during exposure of the sensors to various vapors. The infrared detector can monitor changes in the distribution of resistances instead of merely detecting a single overall resistance. A distribution of responses is more indicative of an analyte compared to the overall resistance that is simply a summation of many different resistances. The present invention advantageously measures a matrix of resistances of the sensor array.

In another aspect, the present invention provides a method for monitoring the quality of a sensor, comprising: photographing the sensor with an infrared camera to generate a thermographic image; and analyzing the thermographic image thereby monitoring the quality of the sensor. In particular, the method for monitoring the quality of the sensor includes applying a voltage to the sensor to cause the sensor to dissipate energy; capturing an image of the sensor with an infrared camera to generate a thermographic image of the sensor while the sensor is dissipating energy; identifying conduction paths in the sensor array as regions having a higher temperature than their surroundings; assessing the uniformity of the temperature distribution is the regions; and monitoring the quality of the sensor using the temperature distribution. In certain preferred aspects, the infrared thermographic image is especially useful in a manufacturing area such as quality control, or quality assurance, to monitor the manufacturing quality of sensor arrays. In this and other embodiments, the uniformity of the temperature distribution of the thermographic image of the sensor array can be computed using a computer-implemented method.

In still yet another embodiment, the present invention provides a method for identifying the conducting path of a sensor, comprising: photographing the sensor with an infrared camera to generate a thermographic image; and analyzing the thermographic image thereby identifying the conducting path of the sensor. In particular, the method for identifying the conduction path of a sensor includes: applying a voltage to

the sensor to cause the sensor to dissipate energy; capturing an image of the sensor with an infrared camera to generate a thermographic image of the sensor while the sensor is dissipating energy; and identifying the conduction paths in the sensor array as regions having a higher temperature than their surroundings.

II. ELECTIONS / RESTRICTIONS

Applicant affirms the provisional election with traverse to prosecute the invention of group I, claims 1-23.

III. CLAIM REJECTIONS UNDER 35 U.S.C. §112

III. A. Rejections Under 35 U.S.C. 112, First Paragraph

The Examiner has rejected claims 19-23 under 35 U.S.C. §112, first paragraph, as containing subject matter which the Examiner alleges was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which is most nearly connected, to make and/or use the invention. To the extent the rejection is applicable to the amended set of claims, Applicant respectfully traverses the rejection.

III.A1. With regard to claim 19, the Examiner alleges that the specification is unclear as to how the thermographic image of sensor is evaluated in assessing the quality of the manufactured sensor.

Applicant respectfully submits that the steps involved in using the thermographic image of the sensor array in assessing the quality of the manufactured sensor is set forth in the specification, on page 5, lines 10-20. Briefly, lines10-20 of page 5 disclose that the steps involved in using the thermographic image of the sensor array in assessing quality involves the identification of non-uniform temperature hot spots in the sensor area. In addition, the uniformity of sensor's temperature distribution can be assessed as is set forth in the specification on page 11, line 30 to page 12, line 25. This

involves the calculation of the sensor's temperature distribution as well as the calculation of an index of uniformity or a uniformity factor; with a higher quality sensor being a sensor that has a more uniform temperature distribution as is depicted by a thermograph of the sensor array while it is dissipating energy.

Furthermore, Applicant has amended independent claim 19 as set forth above to recite how the thermographic image of sensor is evaluated in assessing the quality of the manufactured sensor, as is described in the specification. Applicant respectfully submits that claim 19 as amended contains subject matter that is described in the specification in such a way as to enable one skilled in the art to make or use the invention, and therefore, amended claim 19 overcomes the Examiner's section 112, first paragraph rejection. Furthermore, considering that claims 20-21 include all the limitations of claim 19, from which they depend, these claims are patentable at least to the same extent that independent claim 19 is patentable.

In addition, the Examiner has asked, "what characteristic of the conducting path of the sensor is evaluated in determining the quality of the sensor?" Applicant respectfully submits that the temperature distribution of the conduction paths, as are depicted by the thermographic image, is a characteristic that is evaluated in determining the quality of the sensor.

III. A2. With regard to claim 22, the Examiner alleges that the specification is unclear as to how the conducting path of the sensor is identified using the thermographic image of the sensor. The Examiner has asked, "what characteristic of the thermographic image identifies the conducting path of the sensor?"

Applicant respectfully submits that the steps involved in identifying the conduction path of a sensor is described in the specification on page 4, lines 9-16, as well as by Fig. 2 and its accompanying description beginning on page 5, lines 9-12. Briefly, these steps involve applying power or voltage to the sensor array, capturing a thermographic image of the sensor array using an infrared camera while the array is

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dissipating power, and identifying the conduction paths as the high temperature regions in the thermographic image.

Furthermore, Applicant has amended independent claim 22 as set forth above to recite the steps that are involved in using the thermographic image of the sensor array to identify the sensor's conduction paths. Applicant respectfully submits that claim 22 as amended contains subject matter that is described in the specification in such a way as to enable one skilled in the art to make or use the invention, and therefore, for the reasons set forth above, amended claim 22 overcomes the Examiner's section 112, first paragraph rejection. Furthermore, considering that claim 23 includes all the limitations of claim 22, from which it depends, this claim is patentable at least to the same extent that independent claim 22 is patentable. On view of the foregoing, Applicant respectfully requests the Examiner withdraw the rejection.

III. B. Rejections Under 35 U.S.C. §112 Second Paragraph

The Examiner has rejected claims 19-23 under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. To the extent the rejection is applicable to the amended set of claims, Applicant respectfully traverses the rejection.

III. B1. Regarding Claim 19, the Examiner has inquired about the characteristics evaluated and steps involved in the analysis of the thermographic image of the sensor which indicate the "quality" of the sensor?

As set forth above, Applicant respectfully submits that amended independent claim 19 recites how the thermographic image of sensor is evaluated in assessing the quality of the manufactured sensor, as is supported by the specification. Applicant respectfully submits that amended claim 19 overcomes the Examiner's section 112, second paragraph rejection. Furthermore, considering that claims 20-21 include all

the limitations of claim 19, from which they depend, these claims are patentable at least to the same extent that independent claim 19 is patentable.

III. B2. Regarding claim 22, the Examiner has inquired about the characteristics of the thermographic image that identify the conducting paths of the sensor?

As set forth above, Applicant has amended independent claim 22 to recite what steps are involved in using the thermographic image of the sensor array to identify the sensor's conduction paths. Accordingly, Applicant respectfully submits that amended claim 22 overcomes the Examiner's section 112, second paragraph rejection. Furthermore, considering that claim 23 includes all the limitations of claim 22, from which it depends, this claims is patentable at least to the same extent that independent claim 22 is patentable.

IV. REJECTION UNDER 35 U.S.C. §101

The Examiner has rejected claims 19 and 22 under 35 U.S.C. §101 because allegedly the claimed recitation of a use, without setting forth any steps involved in the process, results in an improper definition of a process.

As set forth above, the Applicant has amended claims 19 and 22 to overcome the Examiner's § 112 rejections. Applicant respectfully submits that claims 19 and 22 as amended respectively set forth steps involved in the process of monitoring the quality of the sensor array and a method for identifying the conducting path of a sensor. Accordingly, Applicant respectfully submits that amended claims 19 and 22 overcome the 35 U.S.C. §101 rejection of these claims.

V. CLAIMS REJECTIONS UNDER 35 U.S.C. §103

The Examiner has rejected claims 1-18 under 35 U.S.C. §103(a) as allegedly being obvious over U.S. Patent No. 6,319,724 to Lewis et al. ("Lewis") in view

of U.S. Patent No. 6,438,497 to Mansky et al. ("Mansky"). Regarding claims 1-3, the Examiner asserts that Lewis teaches all the limitations of independent claim 1 with the exception of an infrared detector operatively associated with each sensor in which the infrared detector measures a response in the presence of an analyte. The Examiner then states that Mansky teaches the use of an infrared detector and therefore, it would have been obvious to one of ordinary skil! in the art to incorporate an optical sensing device, such as an infrared camera, as taught by Mansky, with the detection apparatus comprising a sensor, as taught by Lewis, in order to provide for an effective measuring means for the sensor array.

Turning first to the Lewis reference, Applicant agrees with the Examiner in that Lewis does not teach an infrared detector that is operatively associated with each sensor in a sensor array. Furthermore, Applicant respectfully submits that not only does Lewis not teach an infrared detector that is operatively associated with each sensor in a sensor array, but also Lewis does not suggest and does not possess the motivation to suggest such a feature. Lewis is directed to a technique that allows existing sensor systems to be more effective and efficient by providing enhancements in detection sensitivity to trace analytes. To address the need for detection sensitivity, Lewis teaches a vapor concentrator for an array of sensors. The vapor concentrator of Lewis enables an enhanced detection of trace analytes by directing the flow of the analyte towards a fluid concentrator that is in fluid communication with a sample chamber and absorbing the analyte in the fluid concentrator. Lewis is directed towards a fluid-dynamic and mass transport based enhancement to a system having an array of sensor, to detect trace analytes. This fluid dynamic and mass transport enhancement is embodied in a vapor concentrator. The teachings of Lewis that are directed to enhancing the effectiveness of artificial olefactometry devices are concerned with the mass transfer and fluid dynamic aspects of the transport of trace analytes in a sensing device. Lewis is not concerned with enhancing an artificial olefactometry device by enhancing the device's sensors to be able

to detect additional information from a sensor array using an infrared detector that is operatively associated with each sensor.

Applicant respectfully submits that one skilled in the art would perhaps be motivated by Lewis to improve the fluid dynamic and mass transfer aspects of the operation of an artificial olefactometry device. However, a skilled artisan would not be motivated to capture additional information from a sensor array using an infrared detector as is presently taught and claimed. Therefore, Applicant respectfully submits that for reasons set forth above, not only does Lewis not teach an infrared detector that is operatively associated with each sensor in a sensor array, but also that Lewis does not suggest and does not possess the motivation to suggest such a feature.

Turning next to the Mansky reference, Applicant respectfully submits that Mansky is directed to an apparatus and method for testing materials in an array format using sensors that contact the material being tested (see col. 2, lines 46-50). Specifically, the Mansky reference is motivated by the need for a more direct materials characterization method that involves more contact between the material sample and the sensing apparatus (see col. 2, lines 6-9). In particular, Mansky is seeking a method with a more direct contact between the material sample and the sensing apparatus because, according to Mansky, optical methods are difficult if not impossible to implement for many materials characterization techniques. Specifically, Mansky teaches that, "Although optical methods are particularly useful for characterizing materials or properties in certain circumstances, many material characterization techniques are **difficult or impossible to perform using optical methods.**" (see col. 2 lines 2-5) Applicant respectfully submits that clearly, Mansky is faced with the shortcoming of optical and infrared-based methods for certain materials characterization applications, and with this in the background, Mansky sets out to teach a method that is not an optical-based method. Mansky teaches away from optical methods. For example, see col. 3 line12-14, where Mansky provides that, "this invention allows for property measurements that cannot be done optically." Instead, Mansky teaches a method that relies on a more

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intimate contact between the material samples and the sensing apparatus. Based on these reasons, Applicant respectfully submits that Mansky teaches away from using an optical-based method. Applicant further submits that since Mansky teaches away from using optical based techniques, Mansky does not provide a motivation or suggest the use of an optical-based technique. For reasons set forth above, Applicant respectfully submits that neither Lewis nor Mansky provide a motivation to combine Lewis and Mansky as is suggested by the Examiner. For theses reasons, Applicant respectfully submits that using the teachings of Lewis and Mansky, one skilled in the art would not be motivated to combine Lewis and Mansky, as is suggested by the Examiner. Accordingly, Applicant respectfully requests the withdrawal of the obviousness rejection directed to independent claim 1 and dependent claims 2-3 of the present application. Furthermore, considering that dependent claims 4-18 further limit and add limitations to independent claim 1, from which they depend, then these claims are patentable to the same extent that independent claim 1 is patentable.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "Version with Markings to Show Changes Made."

CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

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If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 925-472-5000.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the claims:

Claims 19 and 22 have been amended as follows:

19. (Amended) A method for monitoring the quality of a sensor, comprising: [photographing said sensor with an infrared camera to generate a thermographic image; and analyzing said thermographic image thereby monitoring the quality of said sensor.]

applying a voltage to said sensor to cause said sensor to dissipate energy;

capturing an image of said sensor with an infrared camera to generate a thermographic image of said sensor while said sensor is dissipating energy;

identifying conduction paths in said sensor array as regions having a higher temperature than their surroundings;

in

assessing the uniformity of the temperature distribution is said regions; and

monitoring the quality of said sensor using said temperature distribution.

22. (Amended) A method for identifying the conducting path of a sensor, comprising: [photographing the sensor with an infrared camera to generate a thermographic image; and analyzing the thermographic image to identify the conducting path of said sensor.]

applying a voltage to said sensor to cause said sensor to dissipate energy;

capturing an image of said sensor with an infrared camera to generate a thermographic image of said sensor while said sensor is dissipating energy; and

identifying said conduction paths in said sensor array as regions having a higher temperature than their surroundings.

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APPENDIX – PENDING CLAIMS

1. A sensor array device for detecting an analyte in a fluid, said device comprising:

an array of sensors; and

an infrared detector operatively associated with each sensor, wherein said infrared detector measures a response in the presence of said analyte.

2. The sensor array device according to claim 1, wherein said infrared detector is an infrared camera.

3. The sensor array device according to claim 1, further comprising a thermographic image display.

4. The sensor array device according to claim 1, wherein said detector measures a matrix of responses.

5. The sensor array device according to claim 4, wherein said matrix is 256 x 256.

6. The sensor array device according to claim 1, wherein at least one of said sensors in the array is a member selected from the group consisting of conducting/nonconducting regions sensors, bulk conducting polymer films, surface acoustic wave devices, fiber optic micromirrors, quartz crystal microbalances, dye impregnated polymeric coatings on optical fibers, sintered metal oxide sensors, phthalocyanine sensors, Pd-gate MOSFET devices, electrochemical cells, conducting polymer sensors, lipid coating sensors, metal FET structures, carbon black-polymer composites, micro-electro-mechanical system devices, micromachined cantilevers, and micro-opto-electro-mechanical system devices.

7. The sensor array device according to claim 6, wherein at least one of said sensors in the array is a conducting/nonconducting regions sensor.

8. The sensor array device according to claim 1, further comprising a computer having a resident comparison algorithm.

9. The sensor array device according to claim 8, wherein said comparison algorithm is performed using a pattern recognition algorithm which is a member selected from the group consisting of principal component analysis, Fisher linear discriminant analysis, soft independent modeling of class analogy, K-nearest neighbors, and canonical discriminant analysis.

10. The sensor array device according to claim 1, wherein said analyte is a member selected from the group consisting of alkanes, alkenes, alkynes, dienes, alicyclic hydrocarbons, arenes, alcohols, ethers, ketones, aldehydes, carbonyls, carbanions, polynuclear aromatics, heterocycles, organic derivatives, biomolecules, microorganisms, fungi, bacteria, microbes, viruses, metabolites, sugars, isoprenes and isoprenoids, fatty acids and their derivatives.

11. The sensor array device according with claim 1, wherein said analyte is a microorganism marker gas.

12. The sensor array device according to claim 1, wherein said sensor array is used in an application selected from the group consisting of environmental toxicology, remediation, biomedicine, material quality control, food monitoring, agricultural monitoring, heavy industrial manufacturing, ambient air monitoring, worker protection, emissions control, product quality testing, oil/gas petrochemical applications, combustible gas detection, H_2S monitoring, hazardous leak detection, emergency response and law enforcement applications, explosives detection, utility and power applications, food/beverage/agriculture applications, freshness detection, fruit ripening

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control, fermentation process monitoring and control, flavor composition and identification, product quality and identification, refrigerant and fumigant detection, cosmetic/perfume applications, fragrance formulation, chemical/plastics/pharmaceuticals applications, fugitive emission identification, solvent recovery effectiveness, hospital/medical applications, anesthesia and sterilization gas detection, infectious disease detection, breath analysis and body fluids analysis.

13. The sensor array device array according to claim 1, further comprising robotic armature for high throughput assay screening.

14. The sensor array device according to claim 1, wherein said array of sensors comprise about 10 to about 100 sensors.

15. The sensor array device according to claim 1 wherein said array of sensors comprise about 100 to about 1000 sensors.

16. The sensor array device according to claim 1, wherein at least two sensors are compositionally different.

17. The sensor array device according to claim 1, wherein said sensor array is part of a handheld device.

18. The sensor array device according to claim 1, wherein said fluid is a gas.

19. A method for monitoring the quality of a sensor, comprising:

applying a voltage to said sensor to cause said sensor to dissipate energy;

capturing an image of said sensor with an infrared camera to generate a thermographic image of said sensor while said sensor is dissipating energy;

identifying conduction paths in said sensor array as regions having a higher temperature than their surroundings;

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assessing the uniformity of the temperature distribution is said regions; and

monitoring the quality of said sensor using said temperature distribution.

20. The method according to claim 19, wherein at least one of said sensors in said array is a member selected from the group consisting of conducting/nonconducting sensors, bulk conducting polymer films, surface acoustic wave devices, fiber optic micromirrors, quartz crystal microbalances, dye impregnated polymeric coatings on optical fibers, sintered metal oxide sensors, phthalocyanine sensors, Pd-gate MOSFET devices, electrochemical cells, conducting polymer sensors, lipid coating sensors, metal FET structures, carbon black-polymer composites, micro-electro-mechanical system devices, micromachined cantilevers, and micro-opto-electro-mechanical system devices.

21. The method according to claim 20, wherein at least one of said sensors in said array is a conducting/nonconducting regions sensor.

22. A method for identifying the conducting path of a sensor, comprising:

applying a voltage to said sensor to cause said sensor to dissipate energy;

capturing an image of said sensor with an infrared camera to generate a thermographic image of said sensor while said sensor is dissipating energy; and

identifying said conduction paths in said sensor array as regions having a higher temperature than their surroundings.

23. The method according to claim 22, wherein said sensor is a member selected from the group consisting of conducting/nonconducting regions sensors, bulk conducting polymer films, surface acoustic wave devices, fiber optic micromirrors, quartz crystal microbalances, dye impregnated polymeric coatings on optical fibers, sintered metal oxide sensors, phthalocyanine sensors, Pd-gate MOSFET devices,

electrochemical cells, conducting polymer sensors, lipid coating sensors, metal FET structures, carbon black-polymer composites, micro-electro-mechanical system devices, micromachined cantilevers, and micro-opto-electro-mechanical system devices.